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EXECUTIVE SUMMARY

LAKEVIEW TGS TEMPORARY FLY ASH STORAGE

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It is planned to construct a temporary fly ash storage pile at Lakeview TGS, between the Station coal pile and the coal pile drainage treatment lagoon system. The fly ash pile will be surrounded by a containment berm made of coal. Laboratory leaching tests have been carried out to predict possible effects of coal pile drainage in leaching soluble species from the ash. From the analytical results it is concluded that any leachate formed should be readily handleable by the existing slaked lime treatment system used to treat coal pile drainage to meet Ontario Ministry of the Environment guidelines. Moreover, the alkalinity of the ash leachate should complement the existing slaked lime treatment system. No modification to the treatment system should be necessary. No adverse effect (due to leaching of ash by coal pile drainage) is foreseen by locating the temporary fly ash stockpile adjacent to the coal pile.

job	file	date	report no.
740631-222-592	837.71	July 18, 1986	86-142-K

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TO: Mr. T.W.B. MacFarlane
Station Manager
Lakeview TGS

Attn: Mr. H. Makuch

LAKEVIEW TGS TEMPORARY FLY ASH STORAGE

A. Golomb

In connection with proposed above-ground temporary storage of Lakeview TGS fly ash adjacent to the Station coal pile, laboratory leachate extraction tests have been carried out to predict possible effects of coal pile drainage in leaching soluble species from the ash. From the analytical results, it is predicted that any leachate formed should be readily handleable by the existing slaked lime treatment system used to treat coal pile drainage to meet MOE guidelines. Furthermore, the alkalinity of the ash leachate should complement the existing slaked lime treatment system. The quantity of leachate produced should be easily handled by the same facility without modification.

It is planned/1/ to construct a temporary fly ash storage pile at Lakeview TGS, as shown in Figure 1. The pile will be approximately 1.62 ha in area, with a height of 2.5 to 3.1 m. It will stand on a flat, cleared area (formerly part of the coal pile), and the pervious coal sub-layer will be equipped with underdrains leading to the East Ditch. The fly ash pile will be surrounded by a containment berm made of coal. In view of the planned location of the fly ash pile between the station coal pile and the coal pile drainage treatment lagoon system, and considering the surrounding coal berm, it is necessary to know whether coal pile drainage is likely to leach soluble components from the ash, and whether there would be significant adverse environmental effects. This report describes a study of the leaching of Lakeview TGS fly ash with acidic coal pile drainage.

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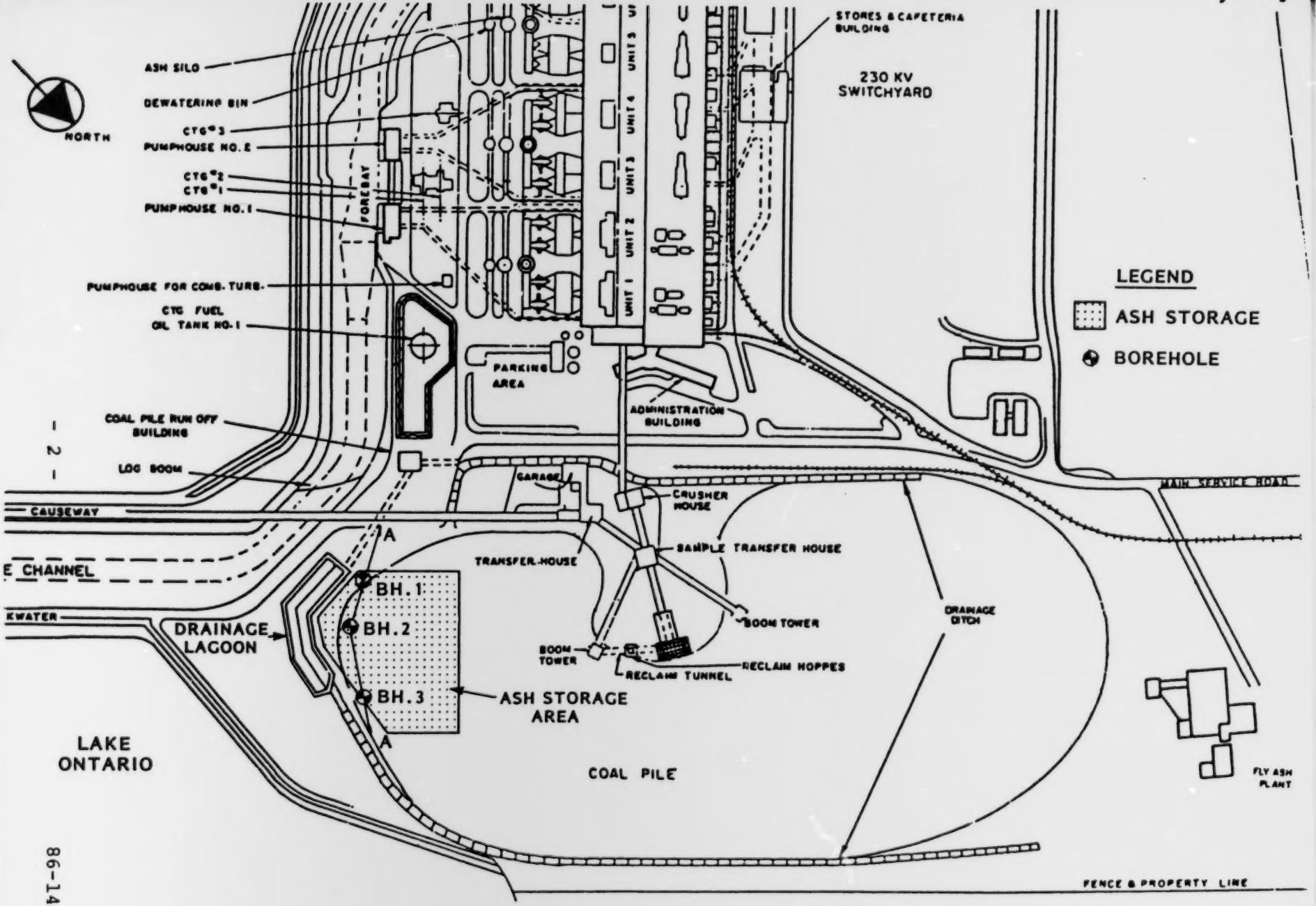

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FIGURE 1

TEMPORARY ASH STORAGE LOCATION AT LAKEVIEW TGS

EXPERIMENTAL

Coal Pile Drainage

The study was initiated under freezing weather conditions in February, 1986, a time of year when it would ordinarily have been difficult to obtain a sample of coal pile drainage. However, a substantial thaw intervened and a free-running coal pile drainage sample was collected from the West Ditch. The sample was found to have a specific conductivity of 520 mS/m, but instead of being acidic, as is usual for coal pile drainage, it was found to have pH 7.5. This can be ascribed to slowdown of chemical and biological activity/2/ at winter temperatures, resulting in diminished rates of sulphuric acid generation.

The "as received" sample was adjusted to pH 2.7 (the annual average pH of coal pile drainage at Lakeview TGS/2/) by addition of concentrated sulphuric acid. (The "worst case" pH of the coal pile is reported/2/ to be 2.4 which is fairly similar). Chemical analysis of the modified (synthetic) coal pile drainage is given in Table II, for an aerobic sample and a nitrogen purged anaerobic sample.

Leachate Extraction Tests

Laboratory leachate extraction tests were carried out by extracting Lakeview TGS fly ash with the modified coal pile drainage (pH 2.7) described above. Two leaching procedures were used, as follows:

(i) ABC Shake Leach Tests

Three successive 20-h shake extractions were carried out on the fly ash removing the extracted solids each time and replacing them with fresh fly ash as described by Ham *et al*/3/. This procedure is designed to yield a set of increasing extract concentrations (ie the ABC sequence). The results are reported in Table I. Effective liquid: solid ratios (w/w) were 10:1 (Extract A), 4.3:1 (Extract B), and 2.3:1 (Extract C). Leaching was done under both aerobic and anaerobic conditions. Data given in parentheses indicate concentrations previously reported/4/ for extraction of Lakeview TGS fly ash with deionized water as lixiviant. It is evident from Table I that when acidic coal pile drainage was used instead of deionized water, little significant change in solute concentrations for most species was observed. Moreover, the high pH of all ABC extracts was accompanied by low concentrations of heavy metals. It is noteworthy that concentrations of boron, selenium and chromium were somewhat elevated, whether coal pile drainage or deionized water was used as extractant.

(ii) Tumble Tests

Tumble test leachate extractions were carried out under conditions similar to the protocol described in the Ontario MOE's Regulation 309/5/. The extractions were carried out by a "co-disposal" and a "monofill" procedure, using the coal pile drainage (pH 2.7) instead of deionized water to extract Lakeview TGS fly ash. Extractions were done under both aerobic and anaerobic conditions. The "co-disposal" extract was finally adjusted to pH 5 by addition of 0.5 N sulphuric acid, instead of 0.5 N acetic acid used in the regular MOE co-disposal extraction procedure. Substitution of sulphuric acid for acetic acid was done because the MOE co-disposal procedure relates ordinarily to landfill sites, where acetic acid is generated by decomposition of organic matter, whereas at Lakeview TGS, sulphuric acid is generated by chemical/biological activity in the coal pile. Sulphuric acid is therefore considered a more 'realistic' extractant in this case. In the "monofill" extraction, the pH was not finally adjusted with acid. In both "co-disposal" and "monofill" tumble tests, the liquid: solid weight ratio was 20:1. Analytical results are reported in Table II.

RESULTS AND DISCUSSION

The analytical results (Tables I and II) show that ABC shake tests and "monofill" extraction of Lakeview TGS fly ash with modified coal pile drainage (pH 2.7) over a wide range of liquid: solid weight ratios (2.3:1 to 20:1) generally give alkaline extracts of pH 10 or higher. These extracts are characterized by low concentrations of heavy metals, and slightly elevated levels of boron, selenium and chromium, comparable to the results of previous extractions of Lakeview TGS fly ash using deionized water.

The "co-disposal" coal pile drainage/fly ash extracts (Table II), being more acidic (final pH 5.0 - 5.5), were found to contain slightly higher concentration of some heavy metals, eg zinc, iron, copper and cadmium than the higher pH extracts, though not seriously so. The "co-disposal" extracts had slightly lower levels of selenium and chromium than the higher-pH extracts.

The general acceptability of Lakeview TGS fly ash for backfill use has previously been established/4/ by a monofill leachate extraction procedure using deionized water as lixiviant. Substitution of coal pile drainage (pH 2.7) for deionized water as extractant yields an alkaline extract (pH ~11) the chemical analysis of which (Table II) shows very similar low levels of trace elements except for boron, selenium and chromium which (again) slightly exceed MOE guideline extract limits recommended for backfill use.

TABLE I

SPECIES	MODIFIED 20-h SHAKE LEACH TESTS/3/											
	LIQUID: SOLID RATIO = 10:1				LIQUID: SOLID RATIO = 4.3:1				LIQUID: SOLID RATIO = 2.3:1			
	A				B				C			
	Aerobic		Anaerobic		Aerobic		Anaerobic		Aerobic		Anaerobic	
pH	10.5	(11.6)	10.7		10.0	(11.8)	10.4		10.7	(12.1)	10.9	
SO_4	1396	(570)	1308		2055	(1170)	1860		2520	(1420)	2010	
Cℓ	20.0	(1.5)	19.6		23.6	(3)	21.0		27.7	(6)	26.8	
Ag	<0.0005	(-)	<0.0005		<0.0005	(-)	<0.0005		<0.0005	(-)	<0.0005	
As	0.011	(<0.1)	0.047		0.013	(-)	0.013		0.047	(-)	0.013	
B *	11.8	(9.7)	11.8		15.7	(11)	18.0		20.9	8.8	23.7	
Ba	1.0	(<2)	1.0		1.0	(<2)	0.5		0.8	(<2)	0.8	
Cd	<0.0002	(0.0002)	<0.0002	(No	<0.0002	(<0.0002)	<0.0002	(No	<0.0002	(<0.0002)	<0.0002	(No
Cr *	0.30	(0.30)	0.30	Prev.	0.50	(0.39)	0.50	Prev.	0.50	(0.44)	0.70	Prev.
Cu	<0.001	(<0.001	<0.001	Data)	<0.001	(<0.001)	0.001	Data)	0.001	(<0.001)	0.001	Data)
Fe	<0.05	(<0.2)	<0.05		<0.05	(<0.02)	<0.05		<0.05	(<0.2)	<0.05	
Hg	<0.0002	(<0.0002)	<0.0002		0.0006	(<0.0002)	<0.0002		<0.0002	(<0.0002)	<0.0002	
F	1.4	(-)	1.0		<0.5	(-)	<0.5		1.2	(-)	1.2	
Mn	<0.05	(<0.1)	<0.05		<0.05	(<0.1)	<0.05		<0.05	(<0.1)	<0.05	
NO_2^-(as N)	0.02	(-)	0.01		0.02	(-)	0.02		0.03	(-)	0.02	
NO_3^-(as N)	0.37	(-)	0.50		0.06	(-)	0.44		0.7	(-)	0.7	
Pb	<0.005	(0.002)	<0.005		<0.005	(<0.002)	<0.005		<0.005	(0.003)	<0.005	
Se *	0.155	(0.06)	0.135		0.195	(0.04)	0.175		0.230	(0.05)	0.230	
U	0.02	(<0.05)	0.04		<0.02	(<0.05)	0.02		0.03	(<0.05)	0.03	
Organic Nitrogen	0.47	(-)	0.49		0.58	(-)	0.66		1.1	(-)	1.1	
Zn	<0.02	(<0.01)	<0.02		<0.02	(<0.01)	<0.02		<0.02	(<0.01)	<0.02	
TDS (105°)	2250	(-)	2120		3189	(-)	2968		3840	(-)	3223	
TOC	2.1	(-)	<1.0		3.3	(-)	2.4		2.4	(-)	2.4	

Data in parenthesis refer to available results previously reported/4/.

* Although the ABC test sequence extract concentrations are not intended by design to be compared with the MOE backfill use monofill test criteria (Table II), it is nevertheless noteworthy that B, Se and Cr in particular exceed those criteria in both Tables I and II.

All concentrations given in mg/L.

The environmental effect of coal pile drainage in leaching ash from the nearby temporary fly ash stockpile is likely to be minimized by a combination of three factors:

(i) Since both the coal pile and the fly ash stockpile with its containment berm made of coal are to be located above ground, intimate mixing of the acidic coal pile drainage and the fly ash is precluded. Most of the coal pile drainage would run off to the east and west collection ditches, and any leaching of ash would be limited to infiltration by any drainage running off from the surrounding coal berm.

(ii) Fly ash has a low permeability, of the order of 10^{-5} cm/s/7/, in contrast with the relatively pervious coal. This would tend to reduce infiltration of any coal drainage that comes into contact with the fly ash in the stockpile.

(iii) The diluting effect of the Station condenser cooling water (CCW) circuit should be sufficient to maintain concentrations of dissolved trace elements below environmentally acceptable discharge criteria.

Sludge from the coal pile drainage treatment lagoons (containing about 95% coal fines, together with calcium sulphate, precipitated metal hydroxides etc) is presently dredged out and disposed of on the coal pile at appropriate intervals. Once the temporary fly ash storage pile is in place no change in this disposal procedure is foreseen as necessary.

The volume of runoff/leachate handled by the existing coal pile drainage treatment facility should be virtually unchanged by presence of a temporary fly ash stockpile, and easily managed without modification.

CONCLUSIONS

Laboratory extraction of Lakeview TGS fly ash with coal pile drainage (adjusted to pH 2.7 with sulphuric acid) under aerobic and anaerobic conditions, and covering a broad range of liquid-to-solid weight ratios, indicates that the resultant alkaline leachate is likely to be of quality readily handleable by the existing slaked lime treatment system used to treat coal pile drainage at the Station. Concentrations of trace heavy metals were generally low, although concentrations of boron, selenium and chromium were slightly elevated, as had been observed in earlier work using deionized water as extractant. With adjustment of the extract down to pH ~5 by sulphuric acid addition during leaching, there were slightly elevated levels of

TABLE II

SPECIES	MODIFIED 20-h MOE TUMBLE TEST (CPD + Lakeview FA) LIQUID: SOLID RATIO = 20:1								"SYNTHETIC" COAL PILE DRAINAGE ANALYSIS (pH 2.7)		MONOFILL MOE TEST: MAXIMUM ACCEPTABLE BACKFILL USE EXTRACT CONCENTRATION /5/	MOE WATER QUALITY OBJECTIVES (1978) FOR SURFACE WATERS /6/
	"CODISPOSAL"				"MONOFILL"							
	Aerobic		Anaerobic		Aerobic		Anaerobic		Aerobic -	Anaerobic		
pH	5.5	(5.0)	5.5	(5.0)	10.9	(12.0)	11.0	(12.0)	2.7	2.7	-	-
SO_4	1850	(-)	1853	(-)	986	(-)	981	(-)	340	345	2500	-
Cℓ	16.0	(-)	16.2	(-)	16.0	(-)	17.0	(-)	15.0	15.5	1250	-
Ag	<0.0005	(<0.05)	<0.0005	(<0.05)	<0.0005	(<0.05)	<0.0005	(<0.05)	<0.0005	<0.0005	0.05	<0.0001
As	0.014	(0.054)	0.011	(0.048)	0.035	(0.040)	0.035	(0.032)	<0.001	<0.001	0.05	<0.1
B *	15.0	(13.5)	15.0	(14)	9.6	(5.2)	8.8	(5.6)	0.25	0.25	5.0	-
Ba	<0.5	(0.5)	<0.5	(<0.5)	0.9	(0.5)	1.0	(1.0)	<0.5	<0.5	1.0	-
Cd	0.0043	(<0.02)	0.0037	(<0.02)	<0.0002	(<0.02)	<0.0002	(<0.0001)	<0.0002	<0.0002	0.005	<0.0002
Cr *	<0.05	(0.1)	<0.05	(<0.1)	0.20	(0.20)	0.20	(0.11)	<0.05	<0.05	0.05	<0.1
Cu	0.006	(-)	0.006	(-)	<0.001	(-)	<0.001	(-)	0.016	0.015	5.0	0.005
Fe	0.35	(-)	0.45	(-)	<0.05	(-)	<0.05	(-)	1.60	1.73	1.5	<0.3
Hg	<0.0002	(<0.0002)	<0.0002	(<0.0002)	<0.0002	(<0.0002)	<0.0002	(<0.0002)	<0.0002	<0.0002	0.001	<0.0002
F	0.5	(<1)	1.0	(<1)	<0.5	(<1)	<0.5	(<1)	<0.5	<0.5	2.4	-
Mn	0.48	(-)	0.52	(-)	<0.05	(-)	<0.05	(-)	0.14	0.15	0.25	-
NO_2(as N)	0.004	(<0.15)	0.004	(<0.15)	0.009	(<0.08)	0.007	(<0.08)	<0.002	<0.002	1.0	-
NO_3(as N)	0.50	(-)	0.50	(-)	0.34	(-)	0.47	(-)	0.40	0.44	10.0	-
Pb	<0.005	(<0.2)	<0.005	(<0.2)	<0.005	(<0.2)	<0.005	(<0.002)	<0.005	<0.005	0.05	<0.025
Se *	0.029	(0.029)	0.031	(0.029)	0.155	(0.042)	0.135	(0.057)	<0.001	0.003	0.01	<0.1
U	0.03	(0.002)	0.02	(<0.001)	<0.02	(<0.001)	<0.02	(<0.001)	<0.02	<0.02	0.02	-
Organic Nitrogen	0.09	(-)	0.13	(-)	0.33	(-)	0.33	(-)	0.08	0.04	0.75	-
Zn	0.07	(-)	0.08	(-)	<0.02	(-)	<0.02	(-)	0.08	0.03	25	<0.03
TDS (105°)	2970	(-)	2960	(-)	1690	(-)	1730	(-)	460	464	2500	Not to increase background by over 1/3
TOC	<1.0	(-)	<1.0	(-)	1.3	(-)	1.2	(-)	<1	<1	25	-

Data in parenthesis refer to available results previously reported/4/.

* Although the ABC test sequence extract concentrations are not intended by design to be compared with the MOE backfill use monofill test criteria, it is nevertheless noteworthy that B, Se and Cr in particular exceed those criteria in both Tables I and II.

All concentrations given in mg/L.

some heavy metals (not seriously so) and slightly lower levels of selenium and chromium. The alkaline nature of the ash leachate should complement the existing slaked lime treatment system used for coal pile drainage, and no modifications to that system are deemed necessary.

The sludge from the existing coal pile drainage lagoons is presently dredged out and deposited on the coal pile at appropriate intervals: no change in this procedure is considered necessary once the temporary fly ash storage pile is in place.

No adverse effect (due to leaching of ash by coal pile drainage) is foreseen by locating the temporary fly ash pile adjacent to the coal pile.

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